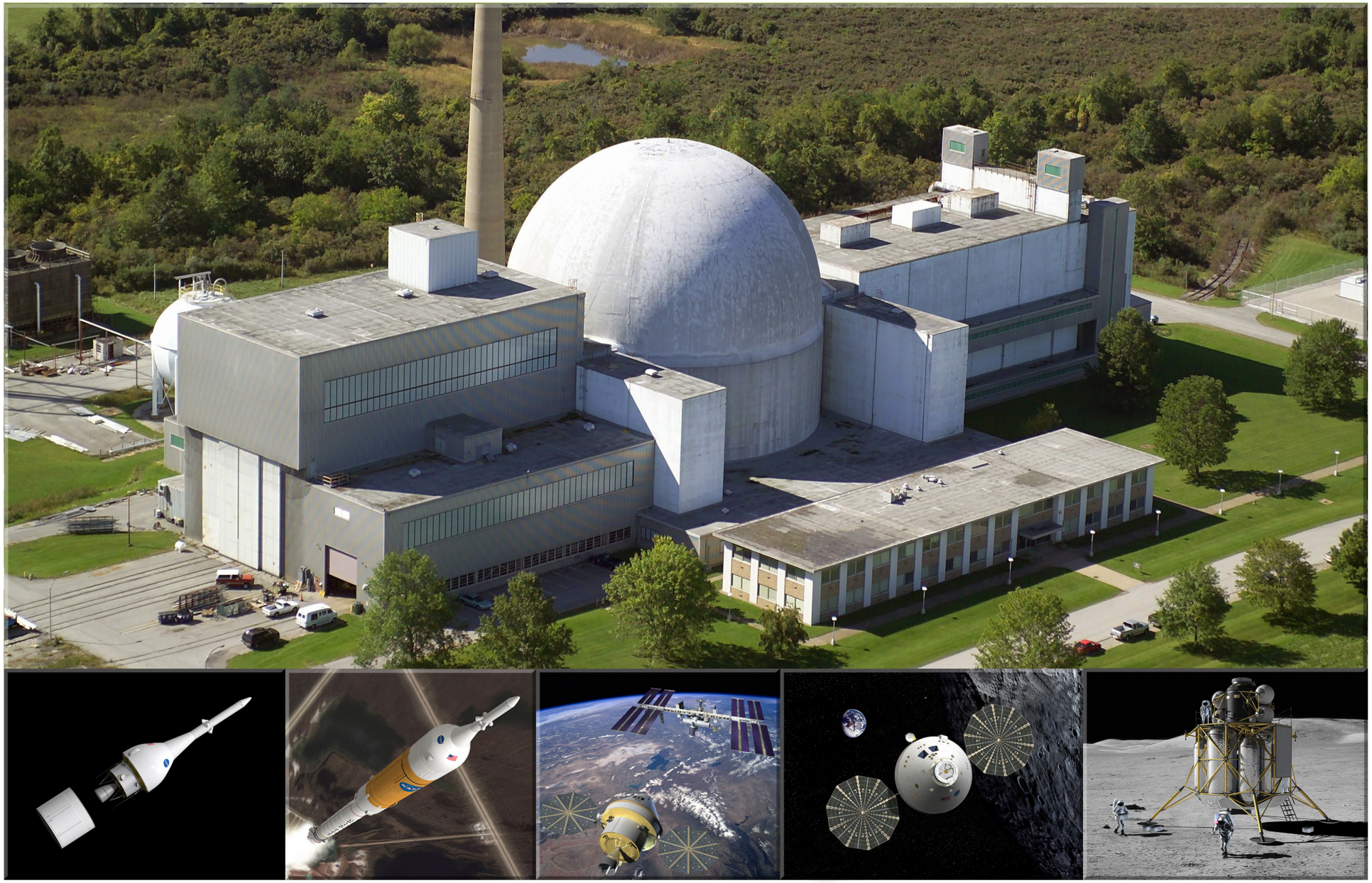
National Aeronautics and Space Administration

Orion Integrated Environmental Testing at the NASA Space Power Facility



Orion Integrated Environmental Testing at the NASA Space Power Facility (SPF)

The NASA Glenn Research Center operates the Plum Brook Station—a vast complex over 10 square miles near Sandusky, Ohio. Plum Brook Station is home of the SPF which houses the world's largest space environment simulation chamber. The chamber's wide-ranging capabilities have been extensively used to test launch vehicle payload fairings, orbital hardware including International Space Station systems, and planetary landing systems like the Mars Pathfinder and the Mars Exploration Rovers' airbag systems. SPF will serve as the primary location for Integrated Environmental Testing (IET) of the Orion Crew Exploration Vehicle (CEV) Ground Test Article and Qualification vehicle. SPF's unique capabilities will permit complete environmental testing of the Orion CEV in a single facility at a single location. This "one-stop shopping" capability reduces project risk by eliminating the need to ship the vehicle to different locations to complete the gamut of testing required for design and production necessary for human space flight. For more information go to exploration.nasa.gov.

Electromagnetic Environmental Effects Facility (E^3F)

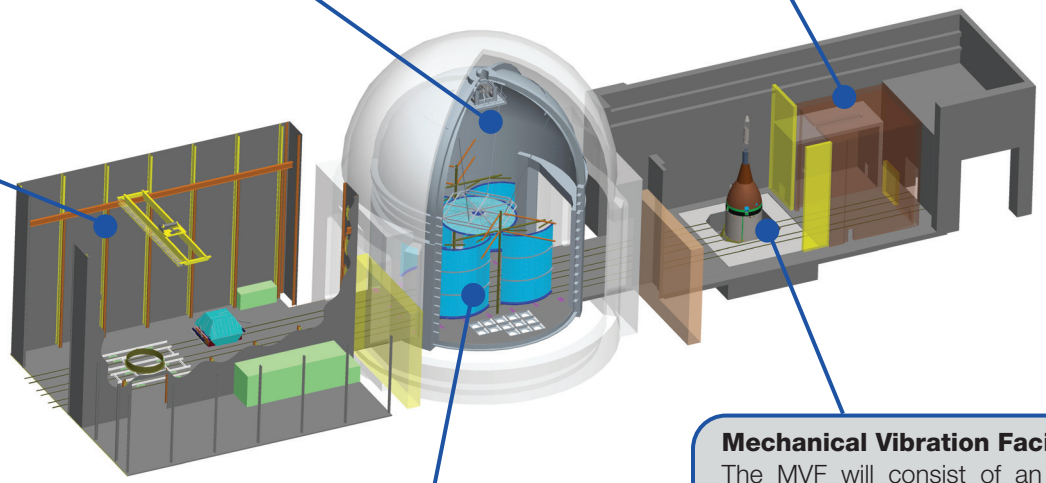
Electromagnetic environmental effects (E^3) testing will take place in ambient conditions inside the thermal vacuum chamber. The concrete and aluminum chamber acts as a radiofrequency shield that enables a quiet environment from other manmade or natural radiofrequencies. E^3 testing is important to assure that the spacecraft's internal systems can operate as expected when bombarded with powerful tracking radars upon launch as well as to operate as expected free from potential interference generated by its own individual systems within the spacecraft.

Reverberant Acoustic Test Facility (RATF)

The RATF, the most powerful acoustic test chamber in the world, will be a steel-reinforced-concrete chamber located in a high bay adjacent to the thermal-vacuum chamber and will be able to physically accommodate a test article nearly 33 ft in diameter. When the Orion vehicle is accelerated through the atmosphere, it will experience extreme aeroacoustic forces. To simulate this environment, sound power will be supplied to the chamber via 23 nitrogen-powered servohydraulic acoustic modulators to reach an overall sound pressure level of 163 decibels in the empty chamber—seven times more powerful than standing next to a jet engine or a Formula 1 race car.

Assembly and Integration Area

In the Assembly and Integration area, test articles are received from shipping and prepared for a series of environmental testing, such as the Orion Ground Test Article (GTA) and the Qualification Vehicle test. The GTA is a structural mockup of the production flight vehicle to be tested for engineering model correlation. It will also serve as a pathfinder for later qualification tests. The Qualification Vehicle is identical in configuration, production processing, and assembly to the actual flight hardware.



Thermal Vacuum Facility (TVF)

Thermal, vacuum, and electromagnetic interference testing of the Orion CEV will be performed in the SPF, known as the world's largest space environment simulation chamber. The chamber measures 100 ft in diameter by 122 ft high. Within this chamber it is possible to perform development and flight qualification testing of complete space flight systems in vacuum and temperature environments ranging from low Earth orbit (LEO) to deep space to planetary surfaces. The vacuum chamber is an aluminum-plate vessel inside a concrete enclosure that can sustain the vacuum of the space environment. While under these conditions, the test article can experience the simulated heat of the Sun (175 °F) and the coldness of deep space (–260 °F) simultaneously. The chamber's large doors (50 by 50 ft) and floor design (300-ton load design) can accommodate large and sophisticated spacecraft test articles.

Mechanical Vibration Facility (MVF)

The MVF will consist of an 20-ft-diameter test table attached to an 8-million-pound-reaction mass by a series of servohydraulic actuators. This facility will be used to perform sinusoidal vibration testing to simulate the harsh mechanical vibration environment experienced during launch. In addition, the MVF can perform modal tests used to identify the natural frequencies of the test article. Vibration testing is critical in determining and understanding operational loads and the interactions of expected and unwanted vibrations. For comparison, vibrations experienced during launch are similar to a high-level earthquake.